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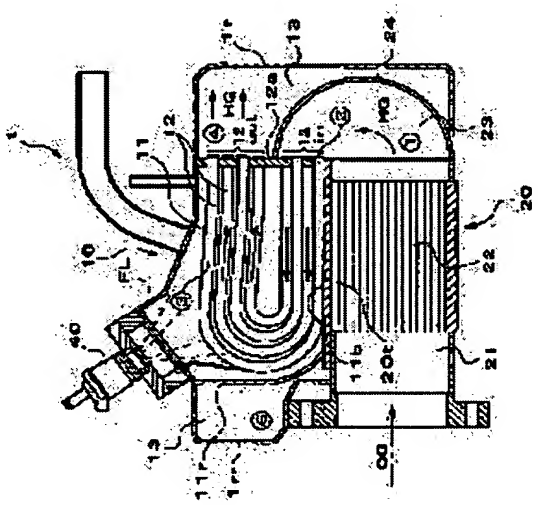
(71)Applicant : HONDA MOTOR CO LTD
(72)Inventor : TACHIHARA TAKAHIRO
MIYANO KOJI
KASAHARA KIYOSHI
NAKAMURA MASAHITO
TOGASAWA SHUICHI

(54) FUEL EVAPORATOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a fuel evaporator with simple construction which can effectively heat and evaporate an original liquid fuel existing in a liquid state at walls and lower portions of the evaporator, also can make it possible to design the whole of a fuel cell system compactly, and can effectively use heat from a catalyst combustion equipment.
SOLUTION: A fuel evaporator 1 including an evaporation chamber for evaporating an original liquid fuel FL by a high-temperature heat media is provided with, a catalyst combustion equipment 20 installed next to the evaporation chamber.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The fuel evaporator characterized by having the catalyzed combustion machine adjoined and prepared for said evaporation chamber in the fuel evaporator which has the evaporation chamber which evaporates a liquid Hara fuel with a heating medium for higher temperature.
[Claim 2] Said catalyzed combustion machine is a fuel evaporator according to claim 1 characterized by being stuck and prepared for said evaporation chamber.
[Claim 3] It is the fuel evaporator according to claim 2 characterized by having the configuration in alignment with the appearance of said arranged thermal tube to said base most closely among the thermal tubes along which the faying surface which said catalyzed combustion machine stuck to said evaporation chamber forms the base of said evaporation chamber, this base is established in said evaporation interior of a room, and said elevated-temperature medium passes.
[Claim 4] Said base of said catalyzed combustion machine is a fuel evaporator according to claim 3 characterized by having the configuration which became depressed towards the center section from the periphery section.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel evaporator with which especially the catalyzed combustion machine was attached about the fuel evaporator of the liquid Hara fuel in a fuel cell system.
[0002]
[Description of the Prior Art] A fuel cell system (FCS) is a generation-of-electrical-energy system which made the nucleus the fuel cell which generates electricity by supplying the oxidation gas containing oxygen to the oxygen pole (anode plate) of a fuel cell while supplying it to the hydrogen pole (cathode) of a fuel cell by making hydrogen into fuel gas. This fuel cell system transforms chemical energy into direct electrical energy, and since there are very few discharges of having high generating efficiency or harmful matter, it attracts attention recently.
[0003] while injecting the liquid Hara fuel which generally consists of mixed liquor of a methanol and water etc. in a fuel evaporator through a original fuel injection equipment in such a system, evaporating a liquid Hara fuel, obtaining original fuel gas and reforming this original fuel gas with a reforming vessel subsequently -- a carbon monoxide -- removing -- hydrogen -- it is made rich fuel gas and is generating electricity by supplying this fuel gas to a fuel cell. When such a fuel cell system is used on condition that [extremely large] a load effect (for example, when using it, being carried in a fuel cell electric vehicle) and a liquid Hara fuel is rapidly injected in a fuel evaporator according to the demand of an output rise, a heating value may be insufficient, all the liquid Hara fuels may be evaporated, and the liquid reservoir (henceforth a "liquid reservoir") of a liquid Hara fuel may be produced in a fuel evaporator. Moreover, in case a fuel cell system is started, also when the fuel evaporator is not fully getting warm, it is easy to produce a liquid reservoir.
[0004] When a liquid reservoir is generated in a fuel evaporator, since a liquid reservoir will evaporate, original fuel gas will be generated and responsibility of a fuel evaporator is worsened even after stopping injection of a liquid Hara fuel, it is not desirable. Moreover, since the produced liquid reservoir evaporates previously from the component which is easy to evaporate when a liquid Hara fuel is mixture, variation may arise in the presentation of original fuel gas, and the engine performance of a fuel cell may fall, without the ability of the case where a reforming machine does not fully demonstrate the engine performance, and a carbon monoxide fully removing.
[0005] For this reason, while preventing generating of a liquid reservoir effectively and improving responsibility of a fuel evaporator, the fuel evaporator 100 as shown in drawing 9 is proposed by Japanese Patent Application No. No. (un-opening to the public) 125666 [11 to] so that warming up of a fuel evaporator can be performed promptly. This fuel evaporator 100 equips the latter-part side of the body 110 of an evaporator, and this body 110 of an evaporator with the original fuel gas fuel injection equipment 140 in the upper part of a superheater 130 and the body 110 of an evaporator. The combustion gas HG which carried out catalyzed combustion of the off-gas (gas containing hydrogen) which occurs with the fuel cell which is not illustrated to this fuel gas evaporator 100 with the catalyzed combustion vessel which is not illustrated is supplied as a

heat source (thermal gas). Combustion gas HG passes along the inside of the thermal tube 112 of the U character mold arranged in the evaporation chamber 111 within the body 110 of an evaporator from 112 inches of inlet-port sections, and reaches outlet section 112out. [many] Subsequently, combustion gas HG passes along the combustion gas path 113 established in the lower part of the evaporation Muromoto object 110, and is led to the superheater 130 attached in the downstream of the body 110 of an evaporator. The liquid Hara fuel floor line which consists of mixed liquor of a methanol and water etc. is injected in the shape of a fog from a fuel injection equipment 140, by the thermal tube 112, is heated, evaporates, and becomes original fuel gas FG. ********** FG which evaporated may be introduced into a latter reforming machine as it is. Furthermore, for the purpose of the temperature control of original fuel gas FG, it is overheated through the inside of the steamy tube 131 of a hot spot 130, and this original fuel gas FG is led to the reforming machine which the hot spot 130 latter part does not illustrate.
[0006] Base 111b [in / in this fuel evaporator 100 / the body 110 of an evaporator] of an evaporation chamber 111 serves as 113t of top faces of the combustion gas path 113. Therefore, since heat is supplied also from base 111b of an evaporation chamber 111, also when generating of a liquid reservoir is prevented and a liquid reservoir is generated, it evaporates promptly. Therefore, the responsibility of the fuel evaporator 100 becomes good.
[0007]
[Problem(s) to be Solved by the Invention] However, in the conventional fuel evaporator, since the heating value given to base 111b is not so large, efficiently, the liquid reservoir which was not enough and was generated heats, and the liquid reservoir generating prevention effectiveness of the evaporation chamber 103 of the fuel evaporator 100 cannot evaporate it. There is also a request of wanting to use the heat from a catalyzed combustion machine effectively furthermore. Moreover, the configuration of the whole fuel cell system is also complicated, and to design the whole system in a compact more was also desired. Therefore, the technical problem of this invention is offering the fuel evaporator which it becomes it is possible to heat and evaporate the liquid reservoir in an evaporator more efficiently with a comparatively easy configuration, and possible to design the whole fuel cell system in a compact, and can use the heat from a catalyzed combustion machine effectively.
[0008]
[Means for Solving the Problem] As a result of inquiring wholeheartedly in view of the actual condition of the above-mentioned conventional technique, by adjoining the evaporator of a fuel evaporator in the catalyzed combustion machine conventionally formed as another object for piping, this invention person etc. finds out that the above-mentioned technical problem is solvable, and came to create this invention. That is, this invention is characterized by having the catalyzed combustion machine adjoined and prepared for said evaporation chamber in the fuel evaporator which has the evaporation chamber which evaporates a liquid Hara fuel with a heating medium for higher temperature. Thus, by constituting, it becomes possible to give many heat more promptly as compared with the case where a combustor is independently prepared like the fuel evaporator of the conventional technique, with the liquid Hara fuel which exists as the liquid Hara fuel which adhered to the wall surface of an evaporation chamber as a drop, or a liquid reservoir. Moreover, since the catalyzed combustion machine was formed adjacently, it becomes possible to design the whole system in a compact more.
[0009] Moreover, in the fuel evaporator of this invention, it is desirable to stick and prepare said evaporation chamber said catalyzed combustion machine. Thus, by constituting, it becomes possible to give further many heat more promptly to the liquid reservoir of a catalyzed combustion machine, the liquid Hara fuel which adhered as a drop in the stuck part, or a liquid Hara fuel. As for the faying surface which said catalyzed combustion machine stuck to said evaporation chamber, in said mode, it is desirable to have the configuration in alignment with the appearance of said thermal tube most arranged on said base closely among the thermal tubes along which the base of said evaporation chamber is formed, this base is established in said evaporation interior of a room, and said elevated-temperature medium passes. Thus, by constituting, it becomes possible to decrease the liquid reservoir space of an evaporation-chamber lower part.

[0010] Moreover, in the fuel evaporator of this invention, said catalyzed combustion machine can form the upper part more thickly than other perimeter sections. Thus, by constituting, it has a heat mass up. On the contrary, in the fuel evaporator of this invention, said catalyzed combustion machine can form the lower part more thickly than other perimeter sections. Thus, by constituting, it has a heat mass caudad.
[0011] In the fuel evaporator of this invention, the faying surface which said catalyzed combustion machine stuck to said evaporation chamber On said base most closely among the thermal tubes along which the base of said evaporation chamber is formed, this base is established in said evaporation interior of a room, and said elevated-temperature medium passes in a mode equipped with the configuration in alignment with the appearance of said arranged thermal tube You may constitute so that it may have the configuration where said base of said catalyzed combustion machine became depressed towards the center section from the periphery section. Thus, by constituting, the heating value near the center of a catalyzed combustion machine becomes high near the periphery, and it becomes possible to evaporate more storage liquid of it. Moreover, in the fuel evaporator of this invention, the heating-medium-for-higher-temperature generating means of the peripheral surface of an evaporation chamber formed in the whole surface by adjoining or sticking at least may be formed possible [an evaporation chamber and division]. Thus, by constituting, at the time of check and exchange of a catalyzed combustion machine, desorption of the catalyzed combustion machine is carried out, and it can be performed.
[0012] Moreover, in the fuel evaporator of this invention, a catalyzed combustion machine can be formed in the die-length direction at a long abbreviation rectangle. Thus, by constituting, the top face to which it sticks with an evaporation chamber as compared with the case where a catalyzed combustion machine is formed in an approximate circle form is formed widely. Moreover, in the fuel evaporator of this invention, a catalyzed combustion machine may be formed so that the cross section may become the approximate circle form of a last quarter. thus, the thing become possible for the area which can be heat-transferred to increase and to tell an evaporation chamber heat efficiently by constituting -- [0013] whose heat recess decreases since surface areas other than a top face decrease [in addition,]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is more concretely explained with reference to an accompanying drawing. However, this invention is not limited to the gestalt of these operations. (Explanation of the whole fuel cell system) Drawing 1 is the whole fuel cell system schematic diagram concerning this invention. The fuel evaporator 1 for a fuel cell system to evaporate a liquid Hara fuel, as shown in drawing 1 , The reforming machine 2 which the original fuel gas which evaporated said liquid Hara fuel with the fuel evaporator 1 is made to react on a solid-state catalyst, and is made into fuel gas, CO removal machine 3 from which the carbon monoxide in said fuel gas generated with the reforming vessel 2 is removed, The fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react, The vapor-liquid-separation equipment 6 which separates and removes moisture from the off-gas of the hydrogen pole of a fuel cell 5, the combustion burner 7 which has the supply line of the auxiliary fuel (for example, methanol) which generates the gas which burns the off-gas supplied from vapor-liquid-separation equipment 6, and serves as a source of heating of the fuel evaporator 1 -- since -- it is mainly constituted.
[0014] When obtaining original fuel gas, a liquid Hara fuel (for example, composite fuel of a methanol and water) is supplied to the fuel evaporator 1 from specified quantity liquid Hara fuel storage tank T with a pump. The liquid Hara fuel supplied to the evaporation chamber 11 of the fuel evaporator 1 is injected by the original fuel injection equipment 40, and evaporates as original fuel gas. As a source of heating of an evaporation chamber 11, although the elevated-temperature gas which generates the off-gas of the hydrogen pole of a fuel cell by carrying out catalyzed combustion with the catalyzed combustion vessel 20 is used at the time of operation, when there is no source of heating at the time of starting etc., an auxiliary fuel (for example, methanol) is burned by the combustion burner 7, and a need heating value can be secured.
[0015] the original fuel gas which occurred in said evaporation chamber 11 is introduced into the

reforming machine 2, and is made to react on a solid-state catalyst (for example, catalyst of a Cu-Zn system) -- having -- hydrogen -- rich fuel gas is manufactured. furthermore, the hydrogen generated with the reforming vessel 2 -- after rich fuel gas is removed by CO removal machine 3 in the carbon monoxide in gas, it is introduced into the fuel cell 5 which generates electricity by making the hydrogen in the fuel gas supplied from said CO removal machine 3, and the oxygen in the air compressed by the air compressor 4 which is an oxidizer supply means react. After the off-gas of the hydrogen pole after reacting with a fuel cell 5 is separated and removed by vapor-liquid-separation equipment 6 in moisture, it burns with the catalyzed combustion vessel 20, and serves as a source of heating of an evaporation chamber 11.
[0016] This invention is characterized by adjoining and forming the catalyzed combustion machine 20 in a specific location about the fuel evaporator 1 in this fuel cell system. Hereafter, the fuel evaporator 1 of this invention is explained based on drawing 2 - drawing 5 . The fuel evaporator of drawing 2 of this operation gestalt is a fracture top view a part, drawing 3 is the A-A' line sectional view of drawing 2 , drawing 4 is the B-B' line sectional view of drawing 2 , and drawing 5 is B-B' of drawing 2 and shows another operation gestalt of this invention. The fuel evaporator 1 mainly consists of an evaporation chamber 11, contiguity and the catalyzed combustion machine 20 especially formed by sticking, and a combustion gas path 12 that is a heating-medium-for-higher-temperature path established in the perimeter of said evaporation chamber 11, and overheats the original fuel gas which evaporated in the evaporation chamber 11 by the combustion gas which went via the combustion gas path by the hot spot 30. [the body 10 of an evaporator which consists of evaporation chambers 11]
(Evaporation chamber) An evaporation chamber 11 is established in the upper part of the thermal tube 12 which carried out U typeface by which a large number arrangement is carried out by standing in a row, tube maintenance plate 12a holding the both ends of said thermal tube 12, and the room which surrounded these, and mainly consists of original fuel injection equipments 40 which injected the liquid Hara fuel in the direction of the entrance side of the thermal tube 12 on the outside of said thermal tube 12. This thermal tube 12 is a tube for passing the combustion gas HG which is the heating medium for higher temperature which can evaporate the liquid Hara fuel generated with said catalyzed combustion vessel 20 to the up 12out (thermal tube upper part) side from 12 inches (thermal tube lower part) of partes basilaris ossis occipitalis, and passing to the fuel gas passage 13, and consists of metals, such as stainless steel excellent in the thermal resistance and corrosion resistance of SUS316 grade.
[0017] Moreover, the original fuel injection equipment 40 is the fuel injection equipment of 1 hydraulic nozzle, for example, an injector, and is for injecting the liquid Hara fuel floor line (spraying), and making it a minute drop. In order to be attached in the evaporation-chamber 11 upper part and to use effectively the amount of potential heat of hot combustion gas HG, the injection direction is the direction (direction which goes to thermal tube maintenance plate 12a) which meets the thermal tube 12. The injection quantity is controlled by back pressure (the injection quantity is proportional to the square root of back pressure) of a nozzle. The combustion gas path 13 which circulates the combustion gas which came out from the evaporation chamber 11 is established in the surroundings of an evaporation chamber 11 to serve both as incubation and heating of an evaporation chamber 11. And a shellside is made to pass the combustion gas passing through said combustion gas path 13, the original fuel gas which evaporated in the tubeside in the evaporation chamber 11 is passed, and it connects with the hot spot 30 which is the heat exchanger of the shell & tube type for heating more than the saturation temperature of original fuel gas so that original fuel gas may not condense.
[0018] The catalyzed combustion machine 20 is a combustor which carries out catalyzed combustion of the off-gas OG, and is made to generate hot combustion gas HG. (Catalyzed combustion machine) It mainly consists of inlet-port passage 21 of Off-gas OG, a catalyst bed 22, and outlet passage 23. The perimeter It is covered by 20t of top-face plates which consisted of metals, such as stainless steel which was excellent in the thermal resistance and corrosion resistance of SUS316 grade like said thermal tube, bottom face-plate 20b, 20s of side-face plates, and 20s' (refer to after-mentioned drawing 6 - drawing 8). In addition, in the desirable mode of this invention, 20t of said top-face plates serves as the pars basilaris ossis occipitalis

of an evaporator 11. That is, it is desirable that direct attachment of the top face of said catalyzed combustion machine 20 is carried out on the inferior surface of tongue of said evaporator 11. As for the cross-section configuration of a catalyst bed 22, it is desirable that it is the abbreviation rectangle formed in the width of face according to the width of face of inferior-surface-of-tongue 11b of an evaporation chamber 11 in order to take a large heating area with an evaporation chamber 11, and it fills up with the catalyst of a honeycomb configuration in it. The catalyst of Pt system is used as the quality of the material of a catalyst. As support, many support of a silica system or an alumina system is used. When the inlet-port passage 21 for introducing the burned body into the catalyzed combustion machine 20 before and behind a catalyst bed 22 and the hot combustion gas which occurred in the catalyst bed 22 flow to the downstream Outlet passage 23 (in the example of drawing) which consists of a curtain board 24 which divided the inside of the combustion gas path 13 so that the flow direction of gas could be changed 180 degrees The off-gas OG of the hydrogen pole of the fuel cell 5 which the cross section is equipped with the shape of a semicircle, and is the burned body That is, the combustion gas HG which introduced the mixed gas of hydrogen and oxygen from the inlet-port passage 21, carried out catalyzed combustion by the catalyst bed 22, made hot combustion gas HG (typically 650-700 degrees C), carried out in this way, and was heated is led to an evaporation chamber 11 from the outlet passage 23.

[0019] In this invention, although preparing an evaporation chamber 11 adjacently is indispensable as for the catalyzed combustion machine 20 and it shows the mode which 20t of top-face plates of a catalyzed combustion machine stuck to the bottom of an evaporation chamber 11 by drawing 2 - especially drawing 4 , the side face of an evaporation chamber 11 may be adjoined and it may constitute 20s of side faces of the catalyzed combustion machine 20, and 20s'. Thus, by constituting, the heat of the catalyzed combustion machine 20 which is an elevated temperature by catalyzed combustion is told to the part which adjoined radiation or the catalyzed combustion machine 20 of an evaporation chamber 11. Moreover, it becomes unnecessary to tie the catalyzed combustion machine 20 and the body 10 of an evaporator with piping as compared with the case where it is conventionally prepared in the catalyzed combustion machine 20 and another object, and the design of a configuration in a compact is attained [becoming easy and]. Moreover, the thin heater H etc. may be made to remodel between the catalyzed combustion machine 20 and an evaporation chamber 11, as shown in drawing 5 . In this case, it is possible to give an evaporation chamber 11 heat from Heater H, even when the catalyzed combustion machine 20 does not start, and to urge evaporation. Therefore, it means [vocabulary / which is used in this invention / "it adjoins"] arranging the catalyzed combustion machine 20 in the location which carries out heat transfer of the heat from the catalyzed combustion machine 20 effective in an evaporation chamber 11. Thus, with the heat told to the body 10 of an evaporator, the liquid Hara fuel floor line and liquid reservoir which exist in the wall surface of an evaporation chamber 11 as a drop evaporate you to be Sumiya, and serve as material gas FG.

[0020] In addition, although it is not restricted especially if the location in which the catalyzed combustion machine 20 is formed in this case can evaporate the liquid Hara fuel which conducts heat to an evaporation chamber 11 as aforementioned, and exists as a liquid in an evaporator 11, as shown in drawing 2 - drawing 4 , it is desirable to stick 20t of top faces of the catalyzed combustion machine 20 and the inferior surface of tongue of an evaporation chamber 11, and it is desirable to carry out especially direct attachment. Moreover, in order to tell an evaporation chamber 11 more heat, as for the cross-section configuration of the catalyzed combustion machine 20, it is desirable that it is an abbreviation rectangle long in the die-length direction of the width of face according to the width of face of inferior-surface-of-tongue 11b of an evaporation chamber 11. Thus, if constituted, it will enable heat to tell efficiently inferior-surface-of-tongue 11b which the evaporation-chamber 11 whole, especially a liquid reservoir tend to produce.

[0021] Hereafter, the desirable mode at the time of attaching 20t of top faces of the catalyzed combustion machine 20 in this invention to inferior-surface-of-tongue 11b of an evaporator 11 is explained based on drawing 6 - drawing 8 . In addition, in these drawings, although shown as a

mode in which 20t of top faces of the catalyzed combustion machine 20 serves as inferior-surface-of-tongue 11b of an evaporator 11, it is also a part of this invention to prepare inferior-surface-of-tongue 11b of 20t of top faces of the catalyzed combustion machine 20 and an evaporator 11 as an exception object, respectively. Drawing 6 - drawing 8 are B of drawing 2 which shows the operation gestalt of this invention respectively, and B' line informality sectional view, and show typically the adhesion relation between the catalyzed combustion machine of this invention, and an evaporation chamber. The thermal tube 12 of an approximate circle form is laid for the cross section by inferior-surface-of-tongue 11b of an evaporation chamber 11 as shown in drawing 6 (a). 20t of top-face plates of the catalyzed combustion machine 20 is carrying out the wave type configuration so that the cross-section configuration of the 12 inches of the lowest sides most allotted to about 20 catalyzed combustion machine among this thermal tube 12 may be met. Thus, if constituted, it will become possible to decrease the liquid reservoir space R which the liquid reservoir of the lower part of an evaporation chamber 11 tends to generate as compared with the case where 20t of top faces of the catalyzed combustion machine 20 is formed in a flat as shown in drawing 6 (b).

[0022] Moreover, since it will have a heat mass above the catalyzed combustion machine 20 formed thickly if 20t of top faces of the catalyzed combustion machine 20 is formed more thickly than other perimeter sections 20b and 20s and 20s' as shown in drawing 7 (a), a transient response response improves and it becomes possible to evaporate the stored liquid Hara fuel also even of after catalyzed combustion. On the contrary, as shown in drawing 7 (b), it is also possible to form more thickly than 20t of other perimeter sections and 20s' inferior-surface-of-tongue 20b of the catalyzed combustion machine 20. Thus, if constituted, when a heat mass will be stored under the catalyzed combustion machine 20, efficiency of heat transfer with an evaporation chamber 11 will improve and radiation area will be expanded, the catalyzed combustion machine 20 functions also on the demand of a sudden evaporation Hara fuel promptly, the fuel evaporator 1 is warmed and started, and it becomes possible to obtain original fuel gas FG.

[0023] Furthermore, it is desirable that may especially constitute in the configuration where 20t of top faces of the catalyzed combustion machine 20 became depressed toward the center section from the periphery section as shown in drawing 8 , and the cross section of the catalyzed combustion machine 20 forms in the abbreviation hemicycle of a last quarter. Thus, by arranging the bottom of the evaporation chamber 11 which is the location where a liquid reservoir tends to exist near the core of the catalyzed combustion machine 20 with most heating values, the heating value near the center of the catalyzed combustion machine 20 becomes high near the periphery, it becomes possible to evaporate more liquid reservoirs, a heating value is used without futility, and evaporation is performed promptly. Moreover, if the cross section of the catalyzed combustion machine 20 forms in the abbreviation hemicycle of a last quarter, since surface areas other than 20t of top-face plates can be reduced, the effectiveness that a heat loss decreases also does so.

[0024] Moreover, it is also possible to set to the fuel evaporator 1 of this invention, and to form the catalyzed combustion machine 20 prepared for the evaporation chamber 11 by adjoining or sticking, enabling free attachment and detachment. In this case, although it is also possible to prepare the catalyzed combustion machine 20 whole, enabling free attachment and detachment, it is common to prepare the part of a catalyst bed 22, enabling free attachment and detachment. Thus, since desorption of a catalyzed combustion machine, especially the catalyst bed 22 which requires check and exchange is carried out and it can be performed by constituting at the time of check and exchange of the catalyzed combustion machine 20, check becomes easy and the cost reduction as a substitute part becomes possible. In addition, the member of the thin form where thermal conductivity is high may be made to pinch between the catalyzed combustion machine 20 and an evaporation chamber 11. In this case, distortion by the thermal stress resulting from the temperature gradient of the catalyzed combustion machine 20 and an evaporation chamber 11 is avoided, and the reinforcement to an oscillating input improves.

[0025]

[Effect of the Invention] Thus, the fuel evaporator of this invention which adjoins and comes to

prepare an evaporation chamber a catalyzed combustion machine becomes possible [giving many heat more promptly as compared with the case where a combustor is independently prepared like the fuel evaporator of the conventional technique by the liquid reservoir of the liquid Hara fuel which adhered to the wall surface of an evaporation chamber as a drop, or an evaporation chamber], and it becomes possible to evaporate these drops and liquid reservoirs of it easily. Moreover, it is not necessary to tie a catalyzed combustion machine and the body of an evaporator with piping, and can design in a compact more. Moreover, if a catalyzed combustion machine is stuck and prepared for an evaporation chamber, the heat transfer effectiveness will increase. Furthermore, the faying surface which the catalyzed-combustion machine stuck to the evaporation chamber forms the base of an evaporation chamber, if it is equipped with the configuration in alignment with the appearance of the thermal tube most arranged on the base of an evaporator closely among the thermal tubes along which a base is established in the evaporation interior of a room, and an elevated-temperature medium passes, it will become possible to decrease the liquid reservoir space of an evaporation-chamber lower part of it, and the amount of a liquid reservoir decreases and the prompt liquid evaporation of it is attained by this. moreover -- if the upper part of a catalyzed combustion machine is formed more thickly than other perimeter sections, since it will have a heat mass up -- after catalyzed combustion -- a liquid reservoir -- evaporation **** -- things become possible and it becomes possible to raise a utilization factor. Conversely, if the lower part of a catalyzed combustion machine is formed more thickly than other perimeter sections, since it will have a heat mass caudad, a catalyst evaporator functions also on the demand of a sudden evaporation Hara fuel promptly, and an evaporator is warmed and it rises. Furthermore, if constituted in the configuration where the top face of a catalyzed combustion machine became depressed toward the center section from the periphery section, the heating value near the center of a catalyzed combustion machine will become high near the periphery, it will become possible to evaporate more liquid reservoirs, a heating value will be used without futility, and evaporation will be performed promptly. Moreover, if it forms possible [an evaporation chamber and division of the catalyzed combustion machine prepared for the evaporation chamber by adjoining or sticking], since desorption of the catalyzed combustion machine is carried out and it can be performed at the time of check and exchange of a catalyzed combustion machine, check becomes easy and the cost reduction as a substitute part becomes possible. In addition, if a catalyzed combustion machine is formed in the die-length direction at a long abbreviation rectangle, since it will compare when a catalyzed combustion machine is formed in an approximate circle form and a fuel evaporator and the top face adjoined or stuck will be formed widely, the area which can be heat-transferred increases. Therefore, it becomes possible to tell an evaporation chamber heat efficiently. Moreover, the area which can be heat-transferred increases, if it forms so that the cross section of a catalyzed combustion machine may become the approximate circle form of a last quarter, since surface areas other than a top face decrease, in addition to becoming possible to tell an evaporation chamber heat efficiently, heat recess will decrease, and it becomes possible to tell an evaporation chamber heat more efficiently.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the fuel cell structure-of-a-system Fig. where the fuel evaporator of this operation gestalt is used.
[Drawing 2] some fuel evaporators of this operation gestalt -- it is a fracture top view.
[Drawing 3] It is the A-A' line sectional view of drawing 2 .
[Drawing 4] It is the B-B' line sectional view of drawing 2 .
[Drawing 5] It is B-B' of drawing 2 and another operation gestalt of this invention is shown.
[Drawing 6] Drawing 6 (a) and (b) are the B-B' line sectional views of drawing 2 showing another operation gestalt of this invention respectively.
[Drawing 7] Drawing 7 (a) and (b) are the B-B' line sectional views of drawing 2 showing another operation gestalt of this invention respectively.
[Drawing 8] It is the B-B' line sectional view of drawing 2 showing still more nearly another operation gestalt of this invention.
[Drawing 9] It is the sectional view showing the conventional fuel evaporator.
[Description of Notations]
FG Hara fuel gas
floor line Liquid Hara fuel
OG Off-gas
HG Combustion gas
H Heater
1 Fuel Evaporator
2 Reforming Machine
3 CO Removal Machine
10 Body of Evaporator
11 Evaporation Chamber
12 Thermal Tube
12a Thermal tube lower part
12b Thermal tube upper part
13 Combustion Gas Path
20 Catalyzed Combustion Machine
20t Catalyzed combustion machine top face
20b Catalyzed combustion machine inferior surface of tongue
20s, 20S' Catalyzed combustion machine side face
21 Inlet-Port Passage
22 Catalyst Bed
23 Outlet Passage
30 Hot Spot
40 Original Fuel Injection Equipment

[Translation done.]

BB

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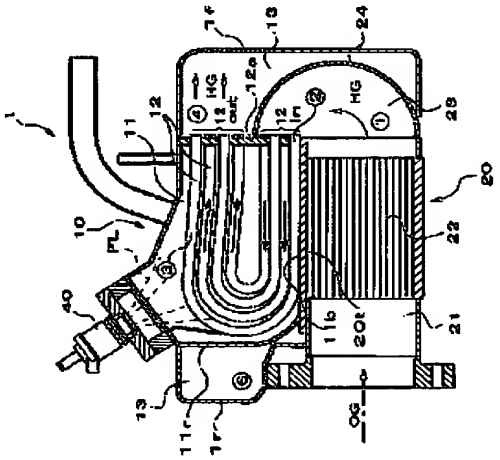
(71)出願人　000005326
本田技研工業株式会社
東京都港区南青山二丁目１番１号
(72)発明者　立原　睦宏
埼玉県和光市中央一丁目４番１号　株式会社本田技術研究所内
(72)発明者　宮野　貴次
埼玉県和光市中央一丁目４番１号　株式会社本田技術研究所内
(74)代理人　100064414
弁理士　磯野　道造

最終頁に続く

(54)【発明の名称】　燃料蒸発器

(57)【要約】
【課題】　比較的簡単な構成で蒸発器内の壁面や下方に液体として存在する液体原燃料を効率的に加熱・蒸発させることが可能であり、燃料電池システム全体をコンパクトに設計することが可能となり、かつ触媒燃焼器からの熱を有効利用することが可能な燃料蒸発器を提供する。
【解決手段】　液体原燃料ＦＬを高温熱媒体により蒸発させる蒸発室を有する燃料蒸発器1において、前記蒸発室に隣接して設けられた触媒燃焼器２０を備えている。



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【特許請求の範囲】

【請求項１】　液体原燃料を高温熱媒体により蒸発させる蒸発室を有する燃料蒸発器において、前記蒸発室に隣接して設けられた触媒燃焼器を備えることを特徴とする燃料蒸発器。

【請求項２】　前記触媒燃焼器は、前記蒸発室に密着して設けられたことを特徴とする請求項１に記載の燃料蒸発器。

【請求項３】　前記触媒燃焼器が前記蒸発室に密着した密着面は、前記蒸発室の底面を形成し、該底面は、前記蒸発室内に設けられ前記高温媒体が通る熱媒チューブのうち最も前記底面に近く配された前記熱媒チューブの外形に沿う形状を備えていることを特徴とする請求項２に記載の燃料蒸発器。

【請求項４】　前記触媒燃焼器の前記底面は、周縁部から中央部に向けて窪んだ形状を有していることを特徴とする請求項３に記載の燃料蒸発器。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、燃料電池システムにおける液体原燃料の燃料蒸発器に関するものであり、特に触媒燃焼器が付設された燃料蒸発器に関する。

【０００２】

【従来の技術】燃料電池システム（ＦＣＳ）は、水素を燃料ガスとして燃料電池の水素極（陰極）に供給するとともに、酸素を含有する酸化ガスを燃料電池の酸素極（陽極）に供給して発電を行う燃料電池を中核とした発電システムである。この燃料電池システムは、化学エネルギーを直接電気エネルギーに変換するものであり、高い発電効率を有することや有害物質の排出量が極めて少ないこと等から最近注目されている。

【０００３】このようなシステムにおいて、一般にメタノールと水の混合液などからなる液体原燃料を、原燃料噴射装置を介して燃料蒸発器内に噴射し、液体原燃料を蒸発させて原燃料ガスを得、次いで、この原燃料ガスを改質器で改質すると共に一酸化炭素を除去して水素リッチな燃料ガスにし、そして、この燃料ガスを燃料電池に供給して発電を行っている。このような燃料電池システムが負荷変動の極端に大きい条件で使用される場合、例えば、燃料電池電気自動車に搭載されて使用される場合、出力アップの要求に応じて液体原燃料を急激に燃料蒸発器内に噴射すると、熱量が不足して液体原燃料のすべてを蒸発させることができず、燃料蒸発器内に液体原燃料の液溜まり（以下「液溜まり」という）を生じることがある。また、燃料電池システムを起動する際など、燃料蒸発器が充分に温まっていない場合にも液溜まりを生じやすい。

【０００４】燃料蒸発器内に液溜まりが生じた場合、液体原燃料の噴射を停止した後も液溜まりが蒸発して、原燃料ガスを発生することになり、燃料蒸発器の応答性を悪くするので好ましくない。また、液体原燃料が混合物の場合は、生じた液溜まりは、蒸発しやすい成分から先に蒸発するため、原燃料ガスの組成にバラツキが生じ、改質器が充分に性能を発揮しない場合や、一酸化炭素が充分に除去できずに燃料電池の性能が低下する場合がある。

【０００５】このため、液溜まりの発生を有効に防止して燃料蒸発器の応答性を良くすると共に、燃料蒸発器の暖機を速やかに行うことができるように、特願平１１－１２５６６６号（未公開）には、図９に示すような燃料蒸発器１００が提案されている。この燃料蒸発器１００は、蒸発器本体１１０と、この蒸発器本体１１０の後段側に過熱器１３０、蒸発器本体１１０の上部に原燃料ガス噴射装置１４０を備える。この燃料ガス蒸発器１００には、図示しない触媒燃焼器により、図示しない燃料電池で発生するオフガス（水素を含むガス）を触媒燃焼させた燃焼ガスＨＧが、熱源（熱媒ガス）として供給される。燃焼ガスＨＧは、入口部１１２inから蒸発器本体１１０内の蒸発室１１１に多数配設されたＵ字型の熱媒チューブ１１２の内側を通り、出口部１１２outに達する。次いで、燃焼ガスＨＧは、蒸発室本体１１０の下部に設けられた燃焼ガス通路１１３を通って、蒸発器本体１１０の下流側に取り付けられた過熱器１３０に導かれる。メタノールと水の混合液などからなる液体原燃料ＦＬは、燃料噴射装置１４０から霧状に噴射され、熱媒チューブ１１２で熱せられて蒸発し、原燃料ガスＦＧになる。蒸発した原燃料ガスＦＧはそのまま後段の改質器に導入してもよい。さらに原燃料ガスＦＧの温度調整を目的として、この原燃料ガスＦＧは、過熱部１３０の蒸気チューブ１３１内を通って過熱され、過熱部１３０後段の図示しない改質器に導かれる。

【０００６】この燃料蒸発器１００は、蒸発器本体１１０における蒸発室１１１の底面１１１ｂが燃焼ガス通路１１３の上面１１３ｔを兼ねるものである。従って、蒸発室１１１の底面１１１ｂからも熱が供給されるため、液溜まりの発生が防止され、また液溜まりが生じた場合も速やかに蒸発する。従って、燃料蒸発器１００の応答性が良くなる。

【０００７】

【発明が解決しようとする課題】しかしながら、従来の燃料蒸発器では、底面１１１ｂに与えられる熱量がさほど大きくないことから、燃料蒸発器１００の蒸発室１０３の液溜まり発生防止効果が充分ではなく、また発生した液溜まりを効率よく加熱・蒸発させることができない。さらに触媒燃焼器からの熱を有効利用したいという要望もある。また、燃料電池システム全体の構成も複雑であり、よりコンパクトにシステム全体を設計することも望まれていた。従って、本発明の課題は、比較的簡単な構成で蒸発器内の液溜まりをより効率的に加熱・蒸発させることが可能であり、燃料電池システム全体をコン

パクトに設計することが可能となり．かつ触媒燃焼器からの熱を有効利用することが可能な燃料蒸発器を提供することである。

【０００８】

【課題を解決するための手段】本発明者等は、上記従来技術の実情に鑑み鋭意検討した結果．燃料蒸発装置の蒸発器に、従来配管にて別体として設けられていた触媒燃焼器を隣接することにより上記課題を解決することができることを見出して、本発明を創作するに至った。すなわち．本発明は．液体原燃料を高温熱媒体により蒸発させる蒸発室を有する燃料蒸発器において、前記蒸発室に隣接して設けられた触媒燃焼器を備えることを特徴とする。このように構成することによって．従来技術の燃料蒸発器のように別に燃焼器を設ける場合に比較して、蒸発室の壁面に液滴として付着した液体原燃料や液溜まりとして存在する液体原燃料により多くの熱をより速やかに付与することが可能となる。また．触媒燃焼器を隣接して設けたので．よりシステム全体をコンパクトに設計することが可能となる。

【０００９】また本発明の燃料蒸発器において．前記触媒燃焼器を前記蒸発室に密着して設けるのが好ましい。このように構成することによって、触媒燃焼器と密着した部分における液滴として付着した液体原燃料や液体原燃料の液溜まりに更に多くの熱をより速やかに付与することが可能となる。前記態様において．前記触媒燃焼器が前記蒸発室に密着した密着面は、前記蒸発室の底面を形成し、該底面が前記蒸発室内に設けられ前記高温媒体が通る熱媒チューブのうち最も前記底面に近く配された前記熱媒チューブの外形に沿う形状を備えているのが好ましい。このように構成することによって、蒸発室下方の液溜まり空間を減少させることが可能となる。

【００１０】また、本発明の燃料蒸発器において．前記触媒燃焼器は．その上部を他の周囲部よりも厚く形成することができる。このように構成することにより．上方に熱マスが備えられる。逆に、本発明の燃料蒸発器において．前記触媒燃焼器は．その下部を他の周囲部よりも厚く形成することができる。このように構成することにより．下方に熱マスが備えられる。

【００１１】本発明の燃料蒸発器において、前記触媒燃焼器が前記蒸発室に密着した密着面は．前記蒸発室の底面を形成し、該底面が前記蒸発室内に設けられ前記高温媒体が通る熱媒チューブのうち最も前記底面に近く配された前記熱媒チューブの外形に沿う形状を備えている態様では、前記触媒燃焼器の前記底面が周縁部から中央部に向けて窪んだ形状を有するように構成してもよい。このように構成することによって、触媒燃焼器の中央付近の熱量が外周近傍よりも高くなり、より多くの貯溜液を蒸発させることが可能となる。また．本発明の燃料蒸発器において、蒸発室の周面の少なくとも一面に隣接あるいは密着して設けられた高温熱媒体発生手段を蒸発室と分割可能に形成してもよい。このように構成することによって、触媒燃焼器の点検・交換時に触媒燃焼器を脱着して行える。

【００１２】また、本発明の燃料蒸発器において．触媒燃焼器を長さ方向に長い略長方形に形成することができる。このように構成することによって．触媒燃焼器を略円形に形成した場合に比較して、蒸発室と密着する上面が広く形成される。また．本発明の燃料蒸発器において．触媒燃焼器を、その断面が下弦の略円形になるように形成してもよい。このように構成することによって、熱伝達可能な面積が増加して、蒸発室に熱を効率よく伝えることが可能となることに加えて．上面以外の表面積が減るので熱逃げが少なくなる

【００１３】

【発明の実施の形態】以下．本発明の実施の形態を、添付図面を参照してより具体的に説明する。しかしながら．本発明は．これらの実施の形態に限定されるものではない。（燃料電池システム全体の説明）図１は．本発明に係る燃料電池システムの全体系統図である。図１に示すように、燃料電池システムは、液体原燃料を蒸発させるための燃料蒸発器１と．燃料蒸発器１で前記液体原燃料を蒸発させた原燃料ガスを固体触媒上で反応させて燃料ガスにする改質器２と．改質器２で生成される前記燃料ガス中の一酸化炭素を除去するＣＯ除去器３と、前記ＣＯ除去器３から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機４により圧縮された空気中の酸素とを反応させて発電を行う燃料電池５と．燃料電池５の水素極のオフガスから水分を分離・除去する気液分離装置６と．気液分離装置６から供給されるオフガスを燃焼して燃料蒸発器１の加熱源となるガスを発生する補助燃料（例えばメタノール）の供給ラインを有する燃焼バーナ７と．から主として構成される。

【００１４】原燃料ガスを得る場合には、液体原燃料（例えばメタノールと水の混合燃料）が、ポンプにより．所定量液体原燃料貯蔵タンクＴから燃料蒸発器１に供給される。燃料蒸発器１の蒸発室１１に供給された液体原燃料は、原燃料噴射装置４０により噴射されて原燃料ガスとして蒸発される。蒸発室１１の加熱源としては．運転時は．燃料電池の水素極のオフガスを触媒燃焼器２０で触媒燃焼することで発生する高温ガスを使用するが．起動時等で加熱源がない場合は．燃焼バーナ７で補助燃料（例えばメタノール）を燃焼して必要熱量を確保できるようになっている。

【００１５】前記蒸発室１１で発生した原燃料ガスは、改質器２に導入され、固体触媒（例えばＣｕ－Ｚｎ系の触媒）上で反応させられて水素リッチな燃料ガスを製造する。さらに．改質器２で生成された水素リッチな燃料ガスは、ガス中の一酸化炭素をＣＯ除去器３で除去された後．前記ＣＯ除去器３から供給される燃料ガス中の水素と酸化剤供給手段である空気圧縮機４により圧縮され

た空気中の酸素とを反応させて発電を行う燃料電池５に導入される。燃料電池５で反応した後の水素極のオフガスは、気液分離装置６で水分を分離・除去された後、触媒燃焼器２０で燃焼され蒸発室１１の加熱源となる。

【００１６】本発明は、かかる燃料電池システムにおける燃料蒸発器１に関し、触媒燃焼器２０を特定の位置に隣接して設けたことを特徴とする。以下、本発明の燃料蒸発器１を、図２～図５に基づいて説明する。図２は、本実施形態の燃料蒸発器の一部破断平面図であり、図３は、図２のＡ－Ａ´線断面図であり、図４は、図２のＢ－Ｂ´線断面図であり、そして図５は図２のＢ-Ｂ´であり、本発明の別の実施形態を示す。燃料蒸発器１は、蒸発室１１から構成される蒸発器本体１０と、蒸発室１１と隣接、特に密着して設けられた触媒燃焼器２０と、前記蒸発室１１の周囲に設けた高温熱媒体通路である燃焼ガス通路１２とから主として構成され、蒸発室１１で蒸発した原燃料ガスを過熱部３０で燃焼ガス通路を経由した燃焼ガスにより過熱する。

（蒸発室）蒸発室１１は、並列して多数配置されるＵ字形をした熱媒チューブ１２と、前記熱媒チューブ１２の両端部を保持するチューブ保持板１２ａと、これらを囲繞した部屋の上部に設けられ、前記熱媒チューブ１２の外側に液体原燃料を熱媒チューブ１２の入口側の方向に噴射するようにした原燃料噴射装置４０とから主として構成される。この熱媒チューブ１２は、前記触媒燃焼器２０で発生した液体原燃料を蒸発可能な高温熱媒体である燃焼ガスＨＧを底部１２ｉｎ（熱媒チューブ下方）から上部１２ｏｕｔ（熱媒チューブ上方）側へと通過させて燃料ガス流路１３へと流すためのチューブであり、ＳＵＳ３１６等の耐熱性および耐食性に優れたステンレス等の金属から構成されている。

【００１７】また、原燃料噴射装置４０は、１流体ノズルの噴射装置、例えばインジェクターであり、液体原燃料ＦＬを噴射（噴霧）して微小な液滴にするためのものである。蒸発室１１上部に取り付けられ、高温の燃焼ガスＨＧの保有熱量を有効に利用するため、噴射方向は熱媒チューブ１２に沿う方向（熱媒チューブ保持板１２ａに向かう方向）となっている。噴射量はノズルの背圧（噴射量は背圧の平方根に比例）で制御される。蒸発室１１の周りには、蒸発室１１の保温と加熱を兼ねて、蒸発室１１から出た燃焼ガスを流通させる燃焼ガス通路１３が設けられている。そして、前記燃焼ガス通路１３を通ってきた燃焼ガスを胴側に通過させて、管側に蒸発室１１で蒸発した原燃料ガスを流して、原燃料ガスが凝縮しないように原燃料ガスの飽和温度以上に加熱するためのシェル＆チューブ式の熱交換器である過熱部３０に接続されている。

【００１８】（触媒燃焼器）触媒燃焼器２０は、オフガスＯＧを触媒燃焼して高温の燃焼ガスＨＧを発生させる燃焼器であり、オフガスＯＧの入口流路２１、触媒層２２、出口流路２３から主として構成されており、その周囲は、前記熱媒チューブと同様にＳＵＳ３１６等の耐熱性および耐食性に優れたステンレス等の金属から構成された上面板２０ｔ、底面板２０ｂ、側面板２０ｓ、２０ｓ´で覆われている（後記の図６～図８参照）。なお、本発明の好ましい態様において、前記上面板２０ｔは、蒸発器１１の底部を兼ねている。すなわち、前記触媒燃焼器２０の上面が前記蒸発器１１の下面に直付けされているのが好ましい。触媒層２２の断面形状は蒸発室１１との伝熱面積を広くとるため蒸発室１１の下面１１ｂの幅に応じた幅に形成された略長方形であることが好ましく、その中にはハニカム形状の触媒が充填されている。触媒の材質としてはＰｔ系の触媒が用いられる。担体としてはシリカ系やアルミナ系の担体が多く用いられている。触媒層２２の前後には該燃焼体を触媒燃焼器２０に導入するための入口流路２１と、触媒層２２で発生した高温の燃焼ガスが下流側に流れるときに、ガスの流れ方向を１８０度変えられるように燃焼ガス通路１３内を区画した隔壁板２４からなる出口流路２３（図の例においては、断面が半円状）とを備えており、該燃焼体である燃料電池５の水素極のオフガスＯＧ、すなわち水素と酸素の混合ガスを入口流路２１から導入して触媒層２２で触媒燃焼して高温の燃焼ガスＨＧ（代表的には６５０～７００℃）とし、このようにして加熱した燃焼ガスＨＧを出口流路２３から蒸発室１１へと導く。

【００１９】本発明においては、触媒燃焼器２０は、蒸発室１１に隣接して設けることが必須であり、図２～図４では触媒燃焼器の上面板２０ｔが蒸発室１１の下に特に密着した態様を示しているが、触媒燃焼器２０の側面２０ｓまたは２０ｓ´を蒸発室１１の側面と隣接して構成してもよい。このように構成することによって、触媒燃焼により高温になっている触媒燃焼器２０の熱が、輻射または蒸発室１１の触媒燃焼器２０と隣接した部分に伝えられる。また、従来触媒燃焼器２０と別体に設けられた場合と比較すると、触媒燃焼器２０と蒸発器本体１０とを配管で結ぶ必要がなくなり構成が簡単になるばかりか、よりコンパクトに設計可能となる。また、図５に示す様に、触媒燃焼器２０と蒸発室１１との間に薄型ヒータＨ等を改装させても良い。この場合、触媒燃焼器２０が立ち上がらない場合でも蒸発室１１にヒータＨから熱を与え、蒸発を促すことが可能である。従って、本発明において使用される用語「隣接する」とは、触媒燃焼器２０からの熱を蒸発室１１に有効に伝熱する位置に触媒燃焼器２０を配置することを意味する。このようにして蒸発器本体１０に伝えられた熱により、蒸発室１１の壁面に液滴として存在する液体原燃料ＦＬや液溜まりがすみやかに蒸発して原料ガスＦＧとなる。

【００２０】なお、この際に触媒燃焼器２０を設ける位置は、前記の通り蒸発室１１に熱を伝えて蒸発器１１内に液体として存在する液体原燃料を蒸発させることが可

能であれば特に制限されるものではないが、図２～図４に示すように触媒燃焼器２０の上面２０ｔと蒸発室１１の下面とを密着させるのが好ましく、特に直付けするのが好ましい。また、より多くの熱を蒸発室１１に伝えるため、触媒燃焼器２０の断面形状は、蒸発室１１の下面１１ｂの幅に応じた幅の長さ方向に長い略長方形であることが好ましい。このように構成すると、蒸発室１１全体、特に液溜まりが生じやすい下面１１ｂに熱が効率よく伝えることが可能となる。

【００２１】以下、本発明における触媒燃焼器２０の上面２０ｔを蒸発器１１の下面１１ｂに付設した場合の好ましい態様を、図６～図８に基づいて説明する。なお、これらの図において、触媒燃焼器２０の上面２０ｔが蒸発器１１の下面１１ｂを兼ねる態様として示しているが、触媒燃焼器２０の上面２０ｔと蒸発器１１の下面１１ｂをそれぞれ別体として設けることも本発明の一部である。図６～図８は、各々本発明の実施形態を示す図２のＢ、Ｂ′縦略式断面図であり、本発明の触媒燃焼器と蒸発室との密着関係を模式的に示している。図６（ａ）に示す通り、蒸発室１１の下面１１ｂには断面が略円形の熱媒チューブ１２が敷設されている。この熱媒チューブ１２のうち、最も触媒燃焼器２０近くに配された最下面１２１ｎの断面形状に沿うように触媒燃焼器２０の上面板２０ｔが波型の形状をしている。このように構成すると、図６（ｂ）に示すように触媒燃焼器２０の上面２０ｔをフラットに形成した場合に比較して、蒸発室１１の下方の液溜まりが発生しやすい液溜まり空間Ｒを減少させることが可能となる。

【００２２】また、図７（ａ）に示すように、触媒燃焼器２０の上面２０ｔを他の周囲部２０ｂ、２０ｓ、２０ｓ′よりも厚く形成すると、肉厚に形成された触媒燃焼器２０の上方に熱マスが備えられるので、過渡応答レスポンスが向上し、触媒燃焼後も、貯留した液体原燃料を蒸発させることが可能となる。逆に、図７（ｂ）に示すように、触媒燃焼器２０の下面２０ｂを他の周囲部２０ｔ、２０ｓ′よりも厚く形成することも可能である。このように構成すると、触媒燃焼器２０の下方に熱マスが蓄えられ、蒸発室１１との伝熱効率が向上し、放射面積が拡大することにより、急な蒸発原燃料の要求にも速やかに触媒燃焼器２０が機能して燃料蒸発器１を暖め立ち上げ、原燃料ガスＦＧを得ることが可能となる。

【００２３】さらに、図８に示すように触媒燃焼器２０の上面２０ｔが周縁部から中央部にむかって窪んだ形状に構成してもよく、また特に触媒燃焼器２０の断面が下弦の略半円形に形成するのが好ましい。このように最も液溜まりが存在し易い位置である蒸発室１１の最下部を最も熱量の多い触媒燃焼器２０の中心付近に配置することによって、触媒燃焼器２０の中央付近の熱量が外周近傍よりも高くなり、より多くの液溜まりを蒸発させることが可能となって、熱量が無駄なく利用されて速やかに蒸発が行われる。また、触媒燃焼器２０の断面が下弦の略半円形に形成すると、上面板２０ｔ以外の表面積を減らせるので、熱ロスが少なくなるという効果も奏する。

【００２４】また、本発明の燃料蒸発器１において、蒸発室１１に隣接または密着して設けられた触媒燃焼器２０を着脱自在に設けることも可能である。この際に触媒燃焼器２０全体を着脱自在に設けることも可能であるが、触媒層２２の部分を着脱自在に設けるのが一般的である。このように構成することによって、触媒燃焼器２０の点検・交換時に触媒燃焼器、特に点検・交換を要する触媒層２２を脱着して行えるので、点検が容易となり、また交換部品としてのコスト低減が可能となる。加えて、触媒燃焼器２０と蒸発室１１との間に、熱伝導率が高い薄形の部材を挟持させてもよい。この場合、触媒燃焼器２０と蒸発室１１の温度差に起因する熱応力での歪を回避し、振動入力に対する強度が向上する。

【００２５】

【発明の効果】このように、蒸発室に触媒燃焼器を隣接して設けてなる本発明の燃料蒸発器は、従来技術の燃料蒸発器のように別に燃焼器を設ける場合に比較して、蒸発室の壁面に液滴として付着した液体原燃料や蒸発室の液溜まりにより多くの熱をより速やかに付与することが可能となり、これらの液滴や液溜まりを容易に蒸発させることが可能となる。また、触媒燃焼器と蒸発器本体とを配管で結ぶ必要がなく、よりコンパクトに設計可能である。また、触媒燃焼器を蒸発室に密着して設けると、伝熱効果が増加する。さらに、触媒燃焼器が蒸発室に密着した密着面は、蒸発室の底面を形成し、底面が蒸発室内に設けられ高温媒体が通る熱媒チューブのうち最も蒸発器の底面に近く配された熱媒チューブの外形に沿う形状を備えていると蒸発室下方の液溜まり空間を減少させることが可能となり、これによって液溜まりの量が減少して速やかな液蒸発が可能となる。また、触媒燃焼器の上部を他の周囲部よりも厚く形成すると、上方に熱マスが備えられるので、触媒燃焼後も液溜まりを蒸発させることが可能となり、利用率を上昇させることが可能となる。逆に触媒燃焼器の下部を他の周囲部よりも厚く形成すると、下方に熱マスが備えられるので、急な蒸発原燃料の要求にも速やかに触媒蒸発器が機能して蒸発器を暖め立ち上げられる。さらに、触媒燃焼器の上面が周縁部から中央部にむかって窪んだ形状に構成すると、触媒燃焼器の中央付近の熱量が外周近傍よりも高くなり、より多くの液溜まりを蒸発させることが可能となり、熱量が無駄なく利用されて速やかに蒸発が行われる。また、蒸発室に隣接または密着して設けられた触媒燃焼器を蒸発室と分割可能に形成すると、触媒燃焼器の点検・交換時に触媒燃焼器を脱着して行えるので、点検が容易となり、また交換部品としてのコスト低減が可能となる。加えて、触媒燃焼器を長さ方向に長い略長方形に形成すると、触媒燃焼器を略円形に形成した場合に比較して、燃

料蒸発器と隣接または密着する上面が広く形成されるので、熱伝達可能な面積が増加する。そのため、蒸発室に熱を効率よく伝えることが可能となる。また、触媒燃焼器の断面が下弦の略円形になるように形成すると、熱伝達可能な面積が増加して、蒸発室に熱を効率よく伝えることが可能となることに加え、上面以外の表面積が減るので熱逃げが少なくなり、より効率的に蒸発室に熱を伝えることが可能となる。

【図面の簡単な説明】

【図１】本実施形態の燃料蒸発器が使用される燃料電池システムの構成図である。

【図２】本実施形態の燃料蒸発器の一部破断平面図である。

【図３】図２のＡ－Ａ' 線断面図である。

【図４】図２のＢ－Ｂ' 線断面図である。

【図５】図２のB-B' であり、本発明の別の実施形態を示す。

【図６】図６（ａ）、（ｂ）は各々、本発明の別の実施形態を示す図２のＢ－Ｂ' 線断面図である。

【図７】図７（ａ）、（ｂ）は各々、本発明の別の実施形態を示す図２のＢ－Ｂ' 線断面図である。

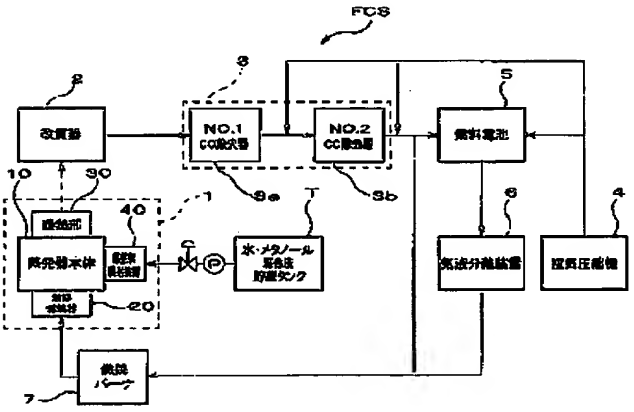
【図８】本発明の更に別の実施形態を示す図２のＢ－Ｂ' 線断面図である。

【図９】従来の燃料蒸発器を示す断面図である。

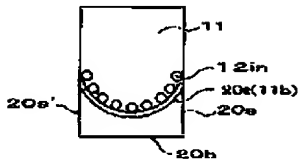
＊【符号の説明】

ＦＧ	原燃料ガス
ＦＬ	液体原燃料
ＯＧ	オフガス
ＨＧ	燃焼ガス
Ｈ	ヒーター
１	燃料蒸発器
２	改質器
３	ＣＯ除去器
１０	蒸発器本体
１１	蒸発室
１２	熱媒チューブ
１２ａ	熱媒チューブ下方
１２ｂ	熱媒チューブ上方
１３	燃焼ガス通路
２０	触媒燃焼器
２０ｔ	触媒燃焼器上面
２０ｂ	触媒燃焼器下面
２０ｓ、２０Ｓ'	触媒燃焼器側面
２１	入口流路
２２	触媒層
２３	出口流路
３０	過熱部
４０	原燃料噴射装置

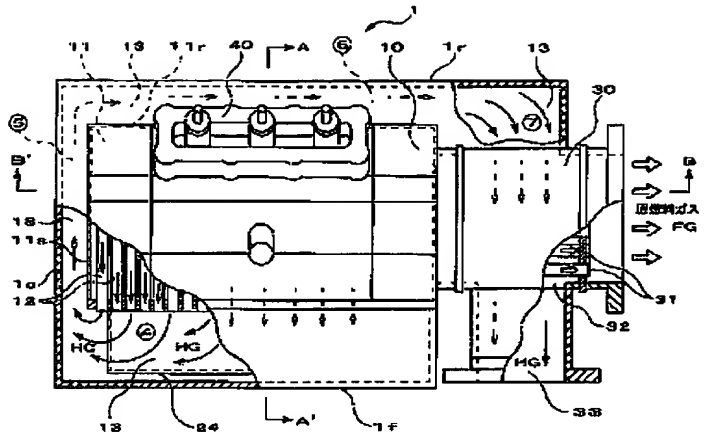
【図１】



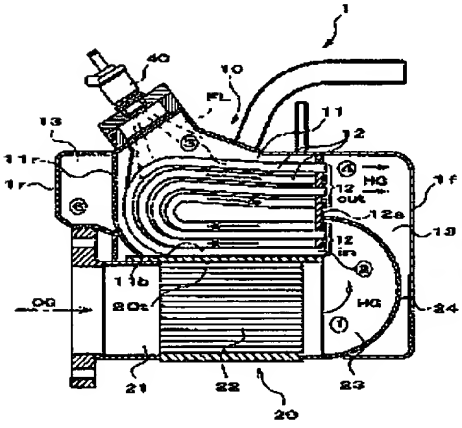
【図８】



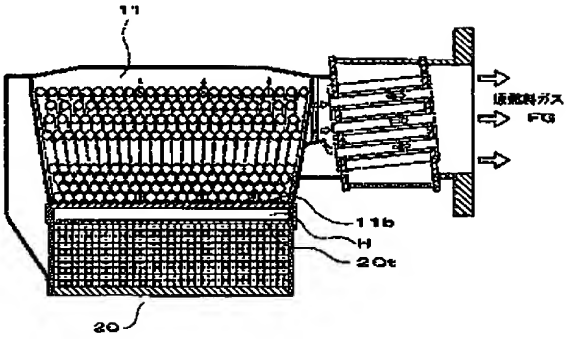
【図２】


11
13
11r
40
A
10
1r
13
30
B
B'
燃焼排ガス
FG
18
11a
1c
12
HG
HG
31
32
HG
33
13
24
A'
1f

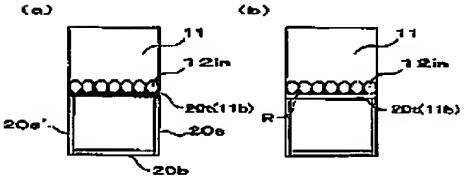
【図３】


1
40
10
FL
11
2
13
11r
1r
12 HG
OUT
1f
12a
13
12 IN
11b
20t
OG
HG
24
21
22
23
20

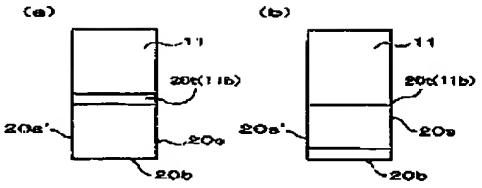
【図５】


11
燃焼排ガス
FG
11b
H
20t
20

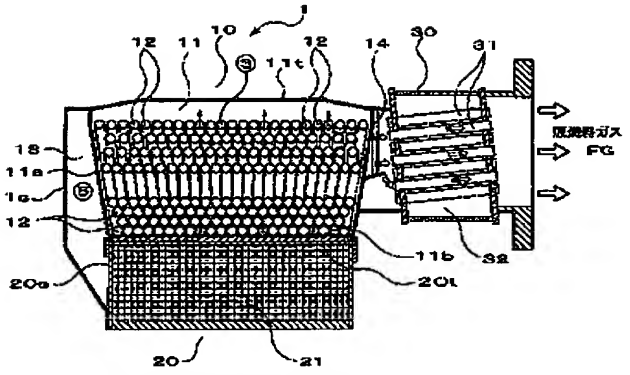
【図６】


(a)
(b)
11
12in
20t(11b)
20s'
20s
20b
R

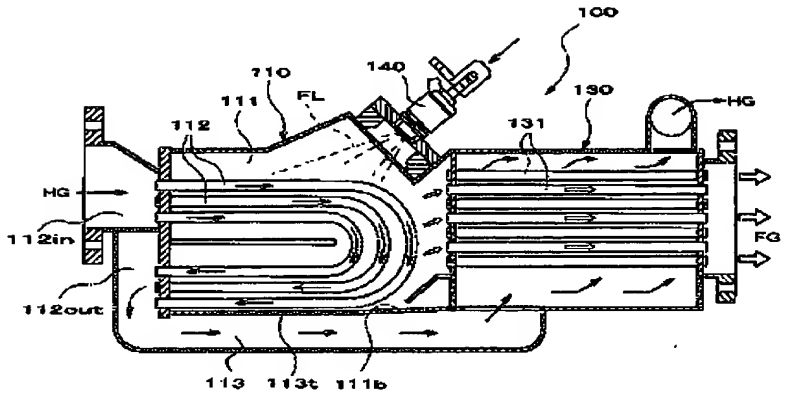
【図７】


(a)
(b)
11
20t(11b)
20s'
20s
20b

【図４】



【図９】



フロントページの続き

(72)発明者　笠原　清志
埼玉県和光市中央一丁目４番１号　株式会社本田技術研究所内
(72)発明者　中村　雅人
埼玉県和光市中央一丁目４番１号　株式会社本田技術研究所内
(72)発明者　斗ヶ沢　秀一
埼玉県和光市中央一丁目４番１号　株式会社本田技術研究所内

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